The Food Safety of Livestock Products (Meatball, Corned Beef, Beef Burger and Sausage) Studied from Heavy Metal Residues Contamination

E Harlia*and RL Balia

Faculty of Animal Science, Padjadjaran University, Jln. Raya Bandung- Sumedang, Sumedang, Indonesia
***Corresponding author email: harliaelin@yahoo.co.id**

Abstract. The aims of animal husbandry improvements are to increase both the quality and the quantity of livestock production and to ensure the safety of the product. It is necessarry for consumers to pay attention to the food safety of livestock product because it is related to human's health. The research was conducted to determine the food safety of livestock product condition by detecting heavy metal residues on several food products from livestock like meatball, corned beef, burger's beef, and sausages. This research was explored by using survey's method and purposive technique sampling, then the resulted data were descriptively analyzed. The observed variables were heavy metal contents such as Plumbum (Pb) and Cadmium (Cd) in which being measured by using AAS (*Atomic Absorption Spectrophotometri*). The result showed that in general, heavy metal residue of Pb from several livestock products (meatball, corned beef, beef burger, and sausages) were smaller than Maximum Residue Limit (MRL), while the Cd's residue was partly over the MRL concentration, therefore further action has to be taken as it affects the human's health.

Key words : food safety, MRL, heavy metal Pb, Cd.

Introduction

Applying food safety standard on a product is very important because it relates closely to human's health. Good food product has a high nutritional quality, as well as free from physical, chemical and biological contaminations. The move on progress of food industry encourages the food producers to produce products that are more practical and durable, but still must have a high nutrition. As an example, beef processing to produce meatball, corned beef, beef burgers and sausages has the purpose to form more practical and durable products, as well as having high nutritional value. However, if they are associated with food safety issues, the products mentioned before are not really safe, considering the possibility of contamination by heavy metals. The development of industry and the increasing number of vehicles become some factors which increase pollution. The advances of technology, industrial activities and the increase in road traffic have led to a significant increase in environmental contamination. The presence of some metal pollutants is everywhere, especially cadmium (Cd), lead (Pb), Chromium (Cr), arsenic (As), nickel (Ni) and mercury (Hg), these metal pollutants spread out into animal rations and food chain, thus it may increase the possibility of toxic effects in humans and animals (Farmer and Farmer, 2000**;** Javed et al., 2009). Heavy metal pollutants can contaminate the products during processing (through the raw material, spices, water and packaging) by inhalation of air and penetration through the skin's surface (Brito, et al., 2005; Raikwar, et al., 2008; Santhi et al., 2008). Heavy metals become dangerous substance because of bioaccumulation system. Heavy metals Pb and Cd contamination in the digestive tract will be absorbed by the body and it spreads throughout the body tissues by blood and the metal will accumulate in body organs, especially kidneys and liver (Blanco-Penedo et al., 2009). Although the amount of heavy metals contamination that goes into the body is just a little, but when it is accumulated in the body, it will cause various health problems in humans (Sharkawy and Amal, 2006; Raikwar et al., 2009). Some diseases caused by heavy metal poisoning are anemia, bone loss, nervous

system disorders, and other disorders on renal system, digestive system, cardiovascular system, reproductive system, as well as endocrine system (Darmono, 2001; Kazantzis, 2004).

Materials and Methods

The materials of the research as follow: meatball, corned beef, burger's beef, as well as cattle's kidney and liver. Meatballs were obtained from 6 (six) Merchants of meatball at Tegalega Bandung area as many as 24 samples . Corned beefs were taken from three common brands sold at traditional market and in supermarkets as many as 18 samples. Beef burgers were obtained from five common brands sold in the Supermarket as many as 19 samples. Sausages were taken from three common brands sold at traditional market and supermarkets as many as 20 samples in total. Kidney and liver from 15 local cattle were obtained at Ciwastra slaughterhouse, Bandung. Those cattle were transported from Plaosan, Magetan regency, East Java.

Observed variables (1). Residue Content of heavy metal Plumbum (Pb). (2). Residue content of heavy metals cadmium (Cd). This research was an exploratory study using survey methods while sampling techniques used a purposive sampling. Research data were descriptively analyzed using the calculated average (mean). The average of Pb content in several processed beef and corned beef products was compared with the MRL (maximum residue limits), the applicable standard was based on SNI 2006; while meatball and burgers' beef, were based on SNI 2003 ; sausages , kidneys and liver were also compared with the MRL based on the applicable standard of POM 1998. The average content of Cd in the diet was compared with EPA 2007 standards.

Results and Discussion

Heavy metal content of Pb in Livestock Products

The heavy metals of Pb and Cd contents on meatballs, corned beef, burgers' beef and sausages, are shown in the Table 1. Table 1. describes the food security situation of livestock products based on the content of heavy metals, the heavy metals has been polluting the cattle's organs (liver and kidney) as well as foods from livestock . The average of Pb content of heavy metals in cow's liver was lower than the Maximum Residue Limits set up by POM which referring FAO 1998, in the provision of 2.000 ppm, whereas the Pb content of heavy metals in cow's kidney was higher. The average of Pb content of heavy metals in the meatball, corned beef, and sausages were still within the permissible limits of the Maximum Residue Limits of SNI 01-3775-2006 which is 1.000 ppm. The average of Pb content of heavy metals in burgers' beef was higher than the Maximum Residue Limits on SNI 2003 (2.000 ppm).

Pb residues contained in the meatball, corned beef and sausage, were lower than the MRL according to SNI 01-3775-2006. This indicates that the product were safe for consumption. However, people should be aware of the accumulative nature of the heavy metal Pb, which will accumulate in the body. Although the consumption of meat products is just in small amounts, for a long time period it can cause health problems. The heavy metal concentration was higher in kidney compared to liver (Szkoda and Żmudzki, 2006; Blanco-Penedo et al., 2009). The concentrations of heavy metals Pb and Cd in the liver, kidneys and most of meat products has been described by researchers in other countries (Doganoc, 1996; Jarup, 2003; Brito, et al., 2005; Sharkawy, and Amal, 2006; Kirkpatrick et al., 2006; Gonzaacutelez-Weller et al., 2006; Szkoda and Żmudzki, 2006; Santhi, et al., 2008; I Blanco-Penedo et al., 2009). Lead would become toxic if it is consumed in the amount exceeds the threshold and can cause acute and chronic poisoning symptoms (Jarup, 2003). The sources of such contamination were probably originated from the main raw material, which is beef, and it may be mixed with the liver and kidneys. Table 1 describes that Pb content in the kidney's cattle of this research was 5.500 ppm, exceeds the results of a research conducted by Jorhem (2003). He states that the kidney is the organ of the body that contains

Table 1. The results of heavy metal Pb content of several livestock products

No.	Livestock products	The average content of Pb (ppm)
1.	Beef liver	0.4683 ± 0.1930
2.	Cattle kidney	5.5000 ± 3.5214
3.	Meatballs	0.2123 ± 0.0666
4.	*Cornet Beef* *	0.3837 ± 0.6603
5.	Burger's beef	2.4457 ± 0.1988
6.	Sausage	0.3639 ± 0.0659
	MRL POM 1998, SNI 2003	2.0000
	MRL SNI 2006 *	1.0000

Maximum Residue Limits (MRL) according to POM 1998, SNI 2003 & SNI 2006

the highest lead levels in comparison with other body parts at around 0.2 ppm. Alternatively, the source of Pb contamination of food livestock were came from the air, water, food materials, cooking utensils and food packaging. The use of spices during processing of meatball, corned beef, burger's beef and sausages is one of source of lead pollution. Plants absorb lead from the soil and the air around and it is further accumulated (Landis, et al. 2004). Planted vegetation nearby the highway will contain lead which is very high because the surrounding air was polluted by exhausted gas from vehicles. This is caused by the use of fuel additives containing lead or TEL (Tetra Ethyl Lead). Krejpcio, et al. (2007) the contents of Pb in garlic, onion and pepper are 0.53 ppm, 0.04 ppm, 0.32 ppm respectively. The Lead contents in various types of normal plantation are ranged from 0.5 to 3 ppm (Landis, et al., 2004), when these plants are used after being harvested, the lead element of the products will contaminate the food. Water used during processing and mixing the dough can be a source of Pb contamination of heavy metals in livestock products. The compound could increase in the drinking water. This is related to the use of water distribution pipes which are covered by water to avoid corrosion of lead. Ingredients element of lead in drinking water can reach 20 µg / L (Heryando, 2004).

Heavy metal content of Cd in Livestock Products

Cd content of heavy metals in meat balls, *Cornet beef,* burgers' beef and sausages were shown in Table 2. Cd is a heavy metal that can contaminate food and water after lead. Table 2 showed that the average content of Cd in meatball products, *Cornet beef,* burgers' beef, sausages brand B and C, as well as in kidney and liver organs exceeded the Maximum Residue Limit according to EPA (2007). Based on Table 2, Cadmium exposure in humans can occur through the food chain. In accordance with the opinion of Raikwar et al. (2008), the distribution of cadmium into the food were often through water, air and soil. In humans and animals, cadmium contamination is usually caused by the food chain (Zhuang et al. 2009). Cadmium is absorbed around five percent and the remaining passes directly into the feces. Gastrointestinal absorption of cadmium in the digestive tract is influenced by several factors; one of them is low-calcium diet that causes higher absorption and deposition of cadmium into the intestinal mucosa, liver, and kidney (Kazantzis, 2004). Cadmium is mainly stored in the liver and kidney where cadmium in the liver is commonly founded to be higher. The distribution of cadmium among several body tissues is depending on eksogenous and endogenous factors (Swiergosz-Kowalewska, 2001). The accumulation of cadmium in the liver and kidneys seems to be mainly dependent on the storage of cadmium in association with cadmium-binding protein, metallothionein (Ellah and Yahia, 2009). Cadmium was detected may be originally from the beef as the main ingredient. Beef used in corned processing were possibly mixed with the internal organs such as kidneys and liver. Heavy metals cadmium is accumulated mostly in the kidney and liver (Wiergosz-Kowalewska. 2001).

Table 2. The results of heavy metal Cd content in some livestock products

No.	Livestock products	The average content of Cd (ppm)
1.	Beef liver	0.1567 ± 0.1176
2.	Cattle kidney	0.8650 ± 0.2616
3.	Meatballs	0.0217 ± 0.0056
4.	*Cornet Beef*	0.0132 ± 0.0165
5.	Burger's beef	0.1119 ± 0.0768
6.	Sausage	0.0138 ± 0.0198
	MRL	0.0100

MRL according to the EPA 1985 and 2007

The research by Jorhem (2003) suggested that the content of cadmium in these organs reached 0.5 ppm.

Table 2 shows the cadmium content in cattle's liver and kidney, sausage, corned beef, meatballs and burger's beef were higher in comparison with the result of research from researchers in other countries (Sharkawy and Amal, 2006 ; Kirkpatrick and Coffin, 2006; Gonzaacutelez-Weller et al., 2006). Based on residue content, more than 5 years old cattle and more than 2 years old pig at slaughter ages were regarded to be unsuitable for human consumption. Heavy metal content of Cd contamination is greater through food than air and water. The food given to cattle was possibly contaminated by cadmium. The raw materials from which bran concentrates are produced and grains have possibility to be contaminated with cadmium. This happens because of the phosphate fertilizer and pesticides that contain cadmium are absorbed by plants. The results of a research in Japan showed that cattle's feed contained 0.09 ppm of cadmium (Rachmawati, 2001). Adding cooking spices affects levels of cadmium in food products. Krejpcio et al. (2007) the contents of Cd in garlic, onion and pepper are 0.04 ppm and 0.05 ppm 0.04 ppm. When used for seasoning then the elements of Cd will come contaminating food products. Herbs and spices such as cultivated and planted ones are possibly to contain pesticides that contain source of cadmium metal. In accordance with the opinion of Jarup (2003), Atafar et al. (2008), the source of phosphate fertilizer cadmium polluted the soil. These findings are also supported by Landis et al. (2004). They found that plants and vegetables had a tendency to absorb heavy metals cadmium than others. Burgers' beef and beef sausages can produce heat denaturation of meat protein. Protein denaturation can be minimized by the addition of ice. However, the ice was made from water that flowing through the pipes. Cadmium metal is used as a stabilizer in the pipeline industry, so the water that flowing through the pipes was contaminated by cadmium (Darmono, 2001; Jarup, 2003, and Kramarova et al. 2005). Cadmium content in the products and cattle's organs (kidney and liver) was lower than the content of lead, however the effects of this metal poisoning is as dangerous as the lead.

Conclusions

In conclusion, there has been contamination of heavy metals Pb and Cd from the environment, and they are further brought into the body of livestock and humans through the food chain. The heavy metals of Pb residues content was lower than the MRL, while the residual of Cd are partly higher than the MRL. It needs to pay more attention on their impacts in human health.

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